CLAIMS

What is claimed is:

1. A method, comprising:

digitally recording a first spatially-heterodyned hologram including spatial heterodyne fringes for Fourier analysis using a first reference beam and a first object beam;

digitally recording a second spatially-heterodyned hologram including spatial heterodyne fringes for Fourier analysis using a second reference beam and a second object beam;

Fourier analyzing the digitally recorded first spatially-heterodyned hologram, by shifting a first original origin of the digitally recorded first spatially-heterodyned hologram to sit on top of a first spatial-heterodyne carrier frequency defined by a first angle between the first reference beam and the first object beam, to define a first analyzed image;

Fourier analyzing the digitally recorded second spatially-heterodyned hologram, by shifting a second original origin of the digitally recorded second spatially-heterodyned hologram to sit on top of a second spatial-heterodyne carrier frequency defined by a second angle between the second reference beam and the second object beam, to define a second analyzed image;

digitally filtering the first analyzed image to cut off signals around the first original origin to define a first result; and

digitally filtering the second analyzed image to cut off signals around the second original origin to define a second result;

performing a first inverse Fourier transform on the first result, and

performing a second inverse Fourier transform on the second result,

wherein the first object beam is transmitted through an object that is at least partially translucent and the second object beam is reflected from the object.

2. The method of claim 1, wherein a first digital image includes the first spatially-heterodyned hologram and a second digital image includes the second spatially heterodyned

hologram.

3. The method of claim 1, wherein the first digital image is generated by a first pixilated detection device and the second digital image is generated by a second pixilated detection device.

4. The method of claim 1, wherein the first angle is not equal to the second angle and a single digital image includes both the first spatially-heterodyned hologram and the second spatially-heterodyned hologram.

5. The method of claim 4, wherein the both the first spatially-heterodyned hologram and the second spatially-heterodyned hologram are digitally recorded with a single pixilated detection device and the single digital image is generated by the single pixilated detection device.

6. The method of claim 5, wherein the first reference beam and the second object beam are not coherent with respect to the second reference beam and the second object beam.

7. The method of claim 6, wherein the spatial heterodyne fringes of the first spatially heterodyned hologram are substantially orthogonal with respect to the spatial heterodyne fringes of the second spatially-heterodyned hologram.

8. The method of claim 1, further comprising calculating a difference in thickness (δ) between a first through section of the object and a second through section of the object as

$$\delta = \frac{\Delta\theta\lambda}{2\pi(N_2 - N_1)}$$

where $\Delta\theta$ is a phase difference, λ is a wavelength of a source of coherent light energy, N_1 is an ambient index of refraction and N_2 is an index of refraction of the object.

9. The method of claim 1, further comprising calculating a phase difference ($\Delta\theta$) between a first portion of the object and a second portion of the object as

$$\Delta\theta = \frac{2\pi d}{\lambda}(N_3 - N_2)$$

where d is a thickness of both the first portion of the object and the second portion of the object, λ is a wavelength of a source of coherent light energy, N_2 is an index of refraction of the first portion of the object and N_3 is an index of refraction of the second portion of the object.

10. The method of claim 1, further comprising calculating an index of refraction (N_2) characterizing a portion of the object as

$$N_2 = \frac{\Delta\theta\lambda}{2\pi d} + N_1$$

where $\Delta\theta$ is a phase difference, λ is a wavelength of a source of coherent light energy and N_1 is an ambient index of refraction.

11. The method of claim 1, further comprising moving the object within a plane that is substantially perpendicular to both an axis defined by the first object beam and an axis defined by the second object beam after digitally recording the first spatially-heterodyned hologram and after digitally recording the second spatially-heterodyned hologram.

12. The method of claim 11, further comprising digitally recording both a third spatially-heterodyned hologram and a fourth spatially heterodyned hologram after moving the object within the plane.

13. The method of claim 1, wherein the reference beam and the object beam are generated by a laser operating in pulse mode.

14. A photolithographic mask inspection process comprising the method of claim 1.

15. A metrology process comprising the method of claim 1.

16. An apparatus, comprising:

a source of coherent light energy;

a transmission reference beam subassembly optically coupled to the source of coherent light;

a reflection reference beam subassembly optically coupled to the source of coherent light;

an object beam subassembly optically coupled to the source of coherent light, the object beam subassembly including a transmission object beam path and a reflection object beam path;

a transmission beamsplitter optically coupled to both the transmission reference beam subassembly and the object beam subassembly;

a reflection beamsplitter optically coupled to both the reflection reference beam subassembly and the object beam subassembly; and

a pixilated detection device optically coupled to at least one member selected from the group consisting of the transmission beamsplitter and the reflection beamsplitter,

wherein the object beam subassembly includes an object that is at least partially translucent, the object i) transmissively optically coupled between the source of coherent light energy and the transmission beamsplitter and ii) reflectively optically coupled between the source of coherent light energy and the reflection beamsplitter.

17. The apparatus of claim 16, further comprising:

another transmission beamsplitter i) optically coupled between the source of coherent light energy and the transmission reference beam subassembly and ii) optically coupled between the source of coherent light energy and the object beam subassembly; and

another reflection beamsplitter i) optically coupled between the source of coherent light energy and the reflection reference beam subassembly and ii) optically coupled between the source of coherent light energy and the object beam subassembly.

18. The apparatus of claim 16, wherein the transmission reference beam subassembly includes an illumination lens.

19. The apparatus of claim 16, wherein the reflection reference beam subassembly includes

an illumination lens.

20. The apparatus of claim 16, wherein the reflection reference beam subassembly includes a reference mirror.

21. The apparatus of claim 16, wherein the object beam subassembly includes an imaging lens.

22. The apparatus of claim 16, wherein the object beam subassembly includes an illumination lens.

23. The apparatus of claim 16, further comprising another pixilated detection device optically coupled to one member selected from the group consisting of the transmission beamsplitter and the reflection beamsplitter.

24. The apparatus of claim 16, wherein the source of coherent light energy includes a laser operated in pulse mode.

25. A photolithographic mask inspection instrument comprising the apparatus of claim 16.

26. A metrology instrument comprising the apparatus of claim 16.